



**AOD413**

**P-Channel Enhancement Mode Field Effect Transistor**

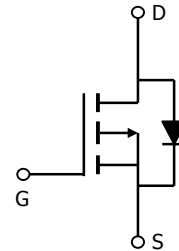
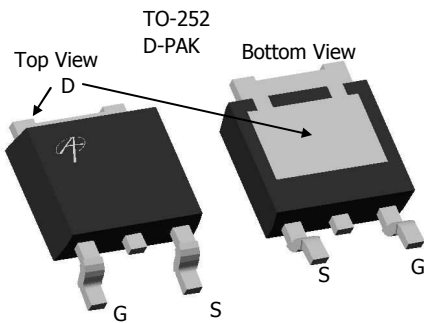
**General Description**

The AOD413 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and low gate resistance. With the excellent thermal resistance of the DPAK package, this device is well suited for high current load applications.

- RoHS Compliant
- Halogen Free\*

**Features**

- $V_{DS}$  (V) = -40V
- $I_D$  = -24A ( $V_{GS}$  = -10V)
- $R_{DS(ON)}$  < 45m $\Omega$  ( $V_{GS}$  = -10V)
- $R_{DS(ON)}$  < 69m $\Omega$  ( $V_{GS}$  = -4.5V)
- 100% UIS Tested
- 100% Rg Tested



**Absolute Maximum Ratings  $T_A=25^\circ\text{C}$  unless otherwise noted**

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	-40	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current <sup>B</sup>	$T_A=25^\circ\text{C}$ <sup>G</sup>	-24	A
	$T_A=100^\circ\text{C}$	-18	
Pulsed Drain Current	$I_{DM}$	-30	
Avalanche Current <sup>C</sup>	$I_{AR}$	-24	A
Repetitive avalanche energy L=0.1mH	$E_{AR}$	30	mJ
Single pulse avalanche energy L=0.3mH	$E_{AS}$	60	mJ
Power Dissipation <sup>B</sup>	$T_C=25^\circ\text{C}$	50	W
	$T_C=100^\circ\text{C}$	25	
Power Dissipation <sup>A</sup>	$T_A=25^\circ\text{C}$	2.5	W
	$T_A=70^\circ\text{C}$	1.6	
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 175	$^\circ\text{C}$

**Thermal Characteristics**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup>	$R_{\theta JA}$	16.7	25	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>		40	50	
Maximum Junction-to-Case <sup>C</sup>	$R_{\theta JC}$	2.5	3	$^\circ\text{C/W}$

Electrical Characteristics ( $T_J=25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=-10\text{mA}$ , $V_{GS}=0\text{V}$	-40			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=-32\text{V}$ , $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$			-1 -5	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$	-1.8	-1.9	-3	V
$I_{D(ON)}$	On state drain current	$V_{GS}=-10\text{V}$ , $V_{DS}=-5\text{V}$	-30			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-10\text{V}$ , $I_D=-12\text{A}$ $T_J=125^\circ\text{C}$		36 56	45 70	$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}$ , $I_D=-8\text{A}$		51	69	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=-5\text{V}$ , $I_D=-12\text{A}$		16		S
$V_{SD}$	Diode Forward Voltage	$I_S=-1\text{A}$ , $V_{GS}=0\text{V}$		-0.75	-1	V
$I_S$	Maximum Body-Diode Continuous Current				-12	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=-20\text{V}$ , $f=1\text{MHz}$		657	850	pF
$C_{oss}$	Output Capacitance			143	185	pF
$C_{rss}$	Reverse Transfer Capacitance			63	90	pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		6.5		$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge (10V)	$V_{GS}=-10\text{V}$ , $V_{DS}=-20\text{V}$ , $I_D=-12\text{A}$		14.1		nC
$Q_g(4.5\text{V})$	Total Gate Charge (4.5V)			7		nC
$Q_{gs}$	Gate Source Charge			2.2		nC
$Q_{gd}$	Gate Drain Charge			4.1		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-10\text{V}$ , $V_{DS}=-20\text{V}$ , $R_L=1.7\Omega$ , $R_{GEN}=3\Omega$		8		ns
$t_r$	Turn-On Rise Time			12.2		ns
$t_{D(off)}$	Turn-Off DelayTime			24		ns
$t_f$	Turn-Off Fall Time			12.5		ns
$t_{rr}$	Body Diode Reverse Recovery Time	$I_F=-12\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		23.2		ns
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=-12\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		18.2		nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The Power dissipation  $P_{DSM}$  is based on  $R_{\theta JA}$  and the maximum allowed junction temperature of  $150^\circ\text{C}$ . The value in any given application depends on the user's specific board design, and the maximum temperature of  $175^\circ\text{C}$  may be used if the PCB allows it.

B: The power dissipation  $P_D$  is based on  $T_{J(MAX)}=175^\circ\text{C}$ , using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

C: Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)}=175^\circ\text{C}$ .

D: The  $R_{\theta JA}$  is the sum of the thermal impedance from junction to case  $R_{\theta JC}$  and case to ambient.

E: The static characteristics in Figures 1 to 6 are obtained using  $<300\mu\text{s}$  pulses, duty cycle 0.5% max.

F: These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of  $T_{J(MAX)}=175^\circ\text{C}$ .

G: The maximum current rating is limited by bond-wires.

H: These tests are performed with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The SOA curve provides a single pulse rating.

\*This device is guaranteed green after data code 8X11 (Sep 1<sup>ST</sup> 2008).

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

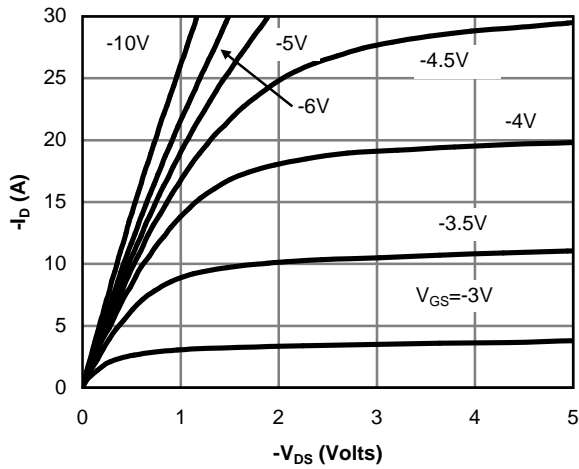


Fig 1: On-Region Characteristics

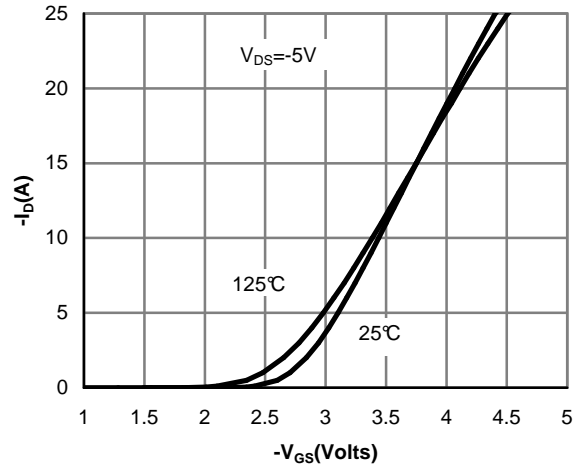


Figure 2: Transfer Characteristics

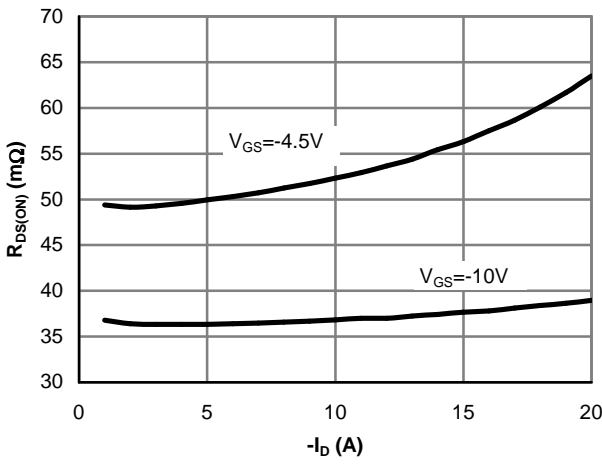


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

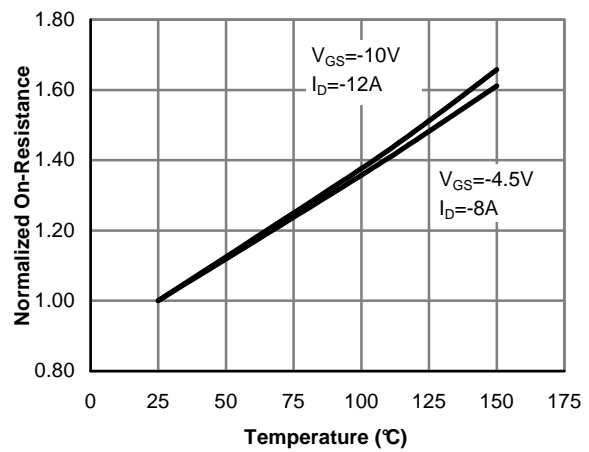


Figure 4: On-Resistance vs. Junction Temperature

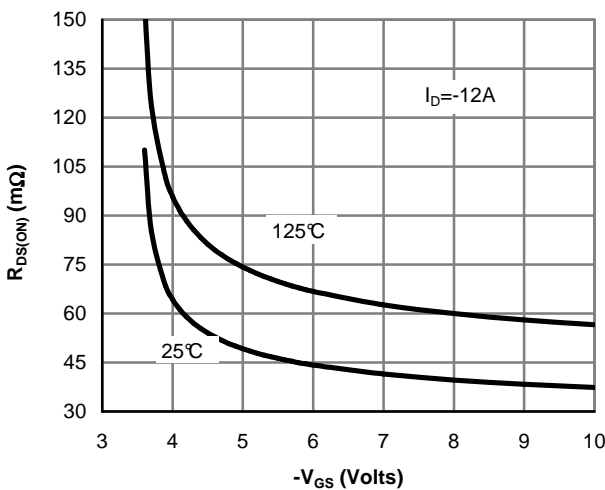


Figure 5: On-Resistance vs. Gate-Source Voltage

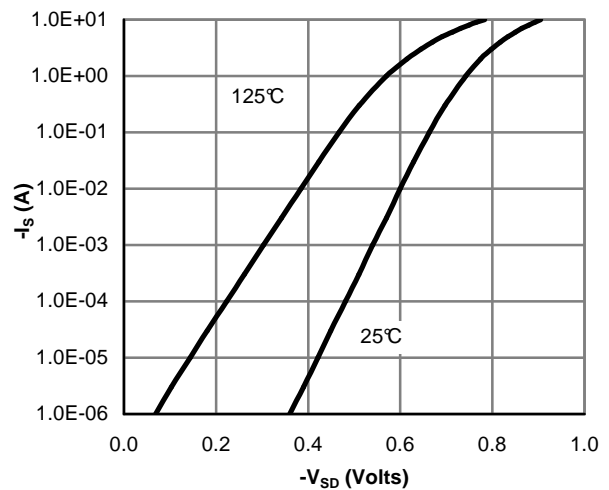


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

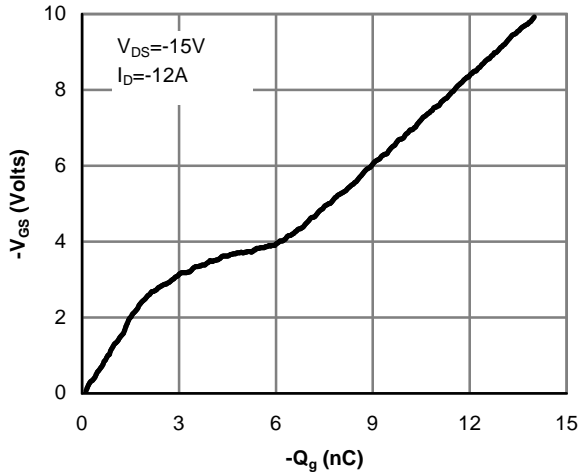


Figure 7: Gate-Charge Characteristics

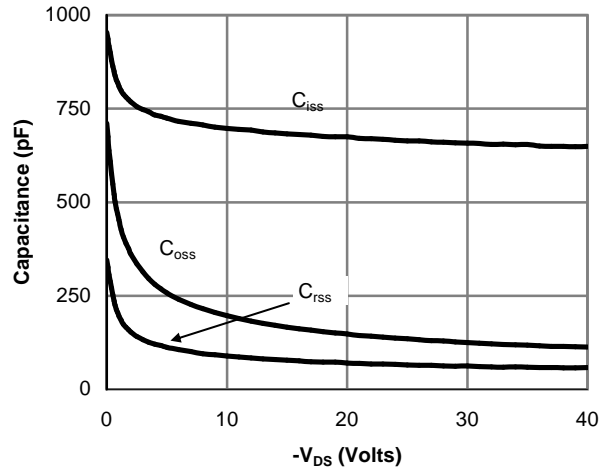


Figure 8: Capacitance Characteristics

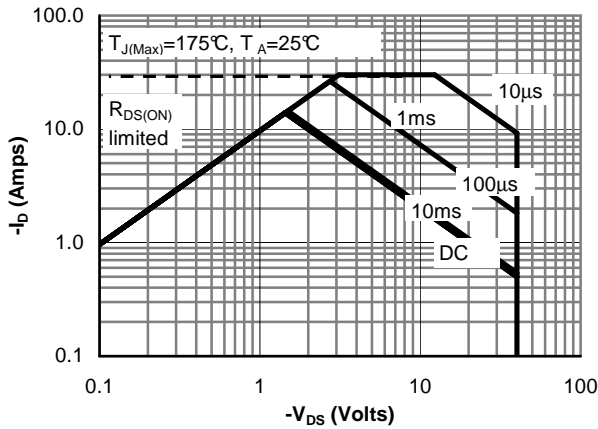


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

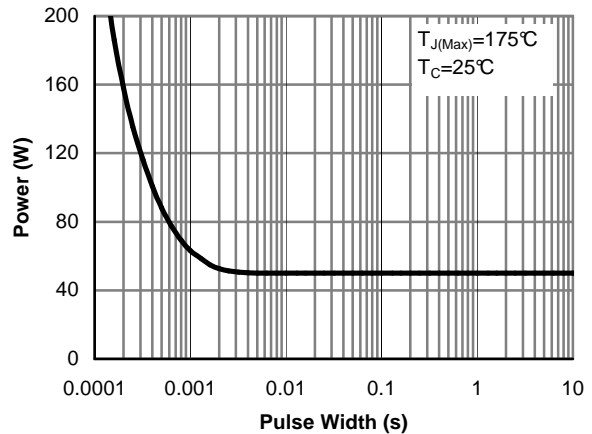


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

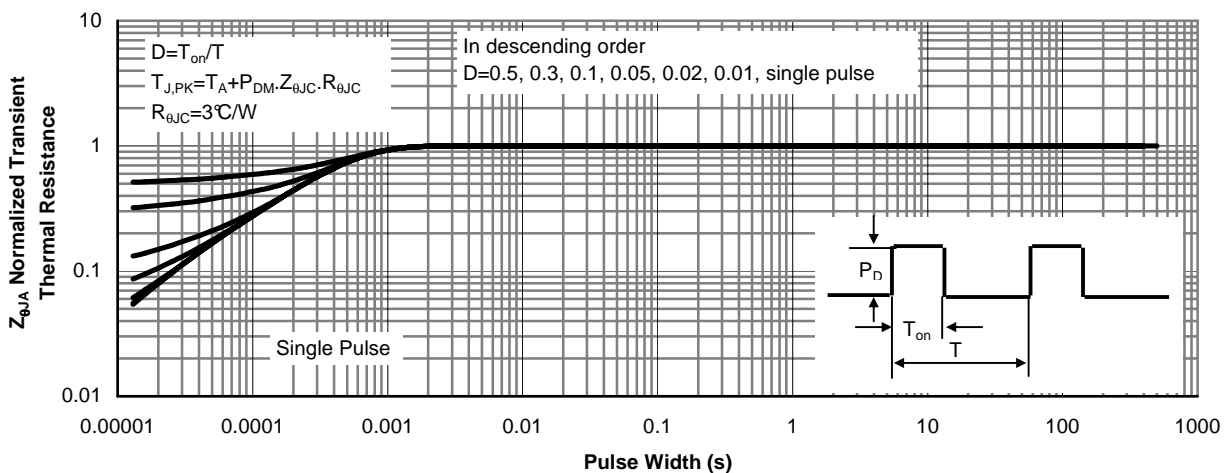


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

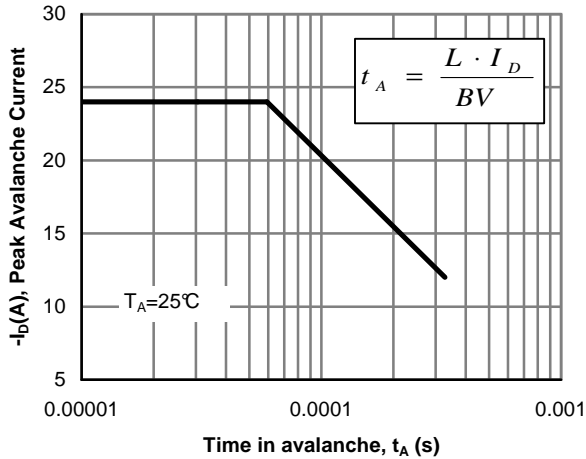


Figure 12: Single Pulse Avalanche capability

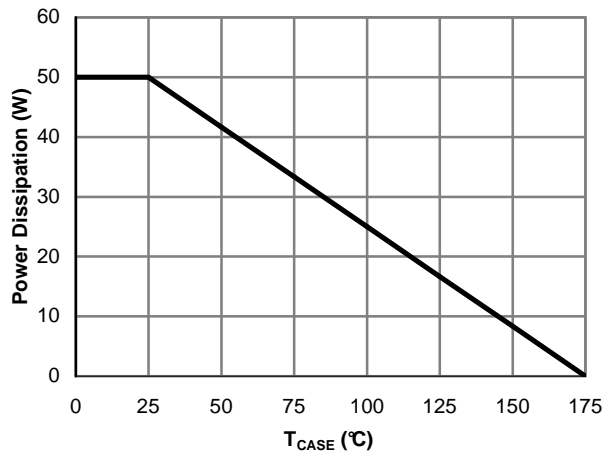


Figure 13: Power De-rating (Note B)

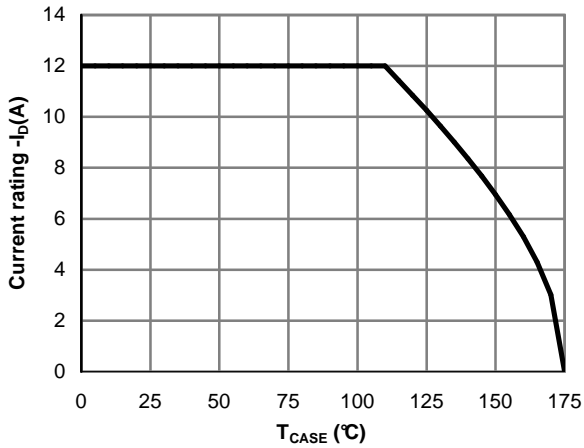


Figure 14: Current De-rating (Note B)

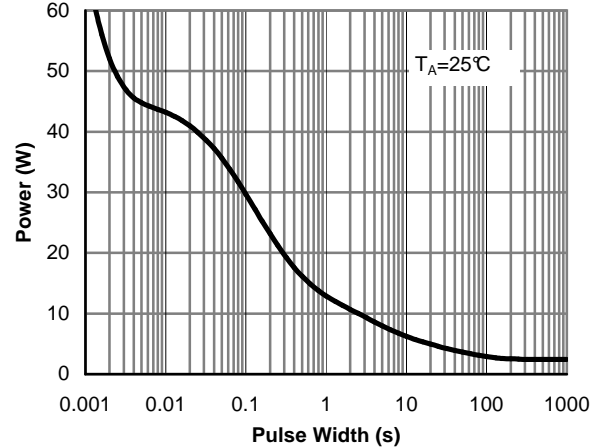


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

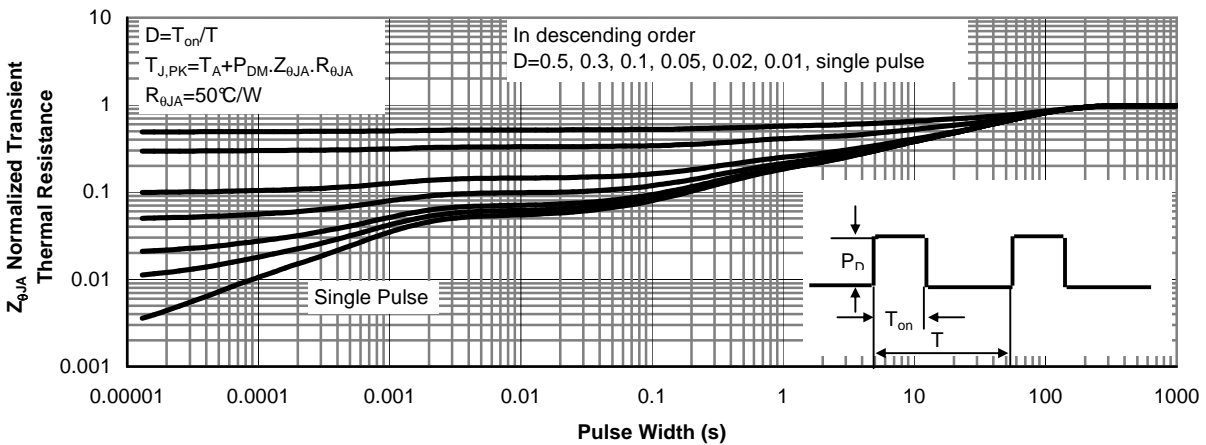
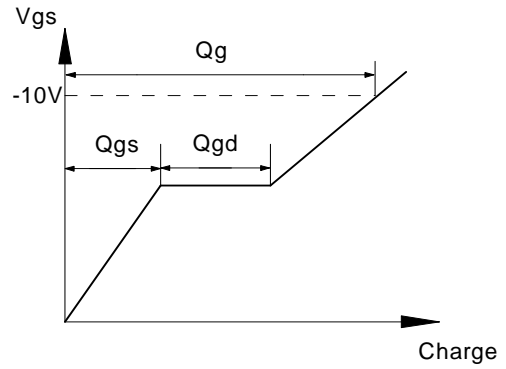
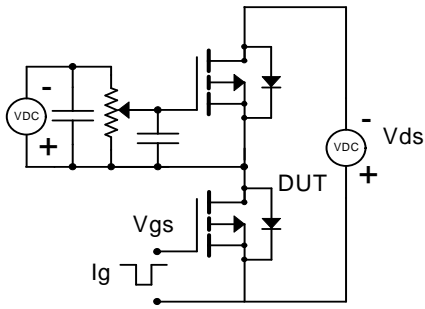
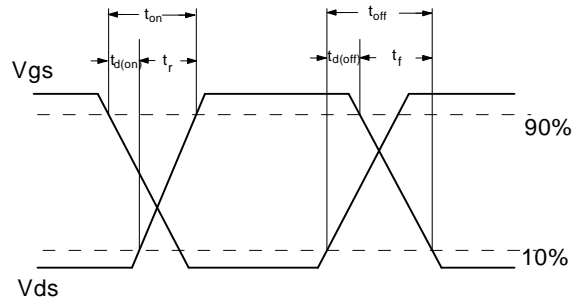
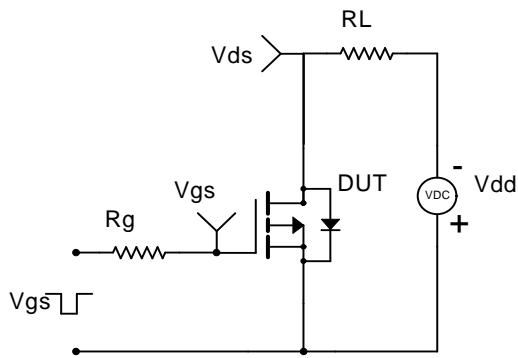


Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)

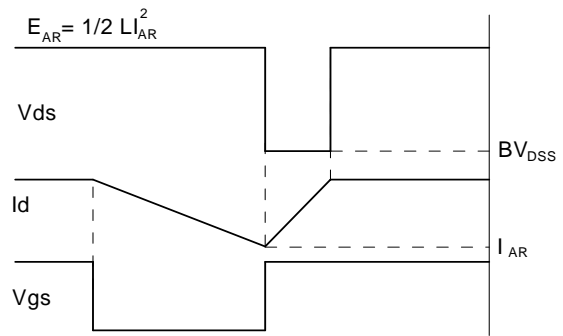
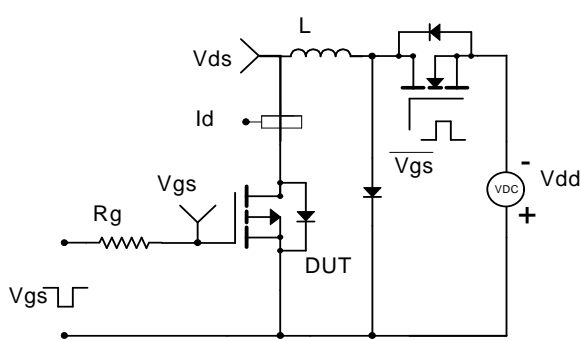
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

